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result set*DB=USPT,PGPB,JPAB,EPAB,DWPI,TDBD; PLUR=YES; OP=ADJ*

<u>L8</u>	polyurethane (fiber or fibre) same antistatic same salt same lubricant	1	<u>L8</u>
<u>L7</u>	polyurethane (fiber or fibre) same antistatic same salt	5	<u>L7</u>
<u>L6</u>	polyurethane (fiber or fibre) same antistatic	14	<u>L6</u>
<u>L5</u>	polyurethane (fiber or fibre) same anti static	2	<u>L5</u>
<u>L4</u>	polyurethane (fiber or fibre)	2228	<u>L4</u>
<u>L3</u>	antistatic near polyurethane (fiber or fibre)	0	<u>L3</u>
<u>L2</u>	antistatic polyurethane (fiber or fibre)	0	<u>L2</u>
<u>L1</u>	6329452 [pn]	2	<u>L1</u>

END OF SEARCH HISTORY

09/554736

TABLE 10-continued

Compa- bilizer	Tensile Strength (psi)	Tensile Modulus (psi)	Gar- den Impact (ft-lb)	HDT Temp (°C)	Mod- ulus (psi)	Flex- ural Strength (psi)

Lica 12	2100	726000	12.9	x	597000	3900
Lica 38	2350	820000	11.4	x	672000	4400

²The screening processes used to segregate wood fibers produce rather broad size distributions; therefore the fiber lengths associated with mesh sizes given above are approximate. As discussed hereinafter, it is the long fibers that contribute most to the improvement in thermal and mechanical properties. 140 mesh (about 100 micrometers); 80 mesh (about 200 micrometers) -30/480 mesh (about 700 micrometers, range about 400 to about 900 micrometers)

[0055] The above results of physical property testing of the compatibilizer polypropylene wood fiber composites show a significant advantage in tensile modulus and flexural modulus. The composites achieve 800,000 to 1.0 million psi tensile modulus and 700,000-800,000 flexural modulus. High Gardener Impact values are achieved along with excellent heat distortion temperatures ranging from about 125 to 140° C. at 264 psi. Such a result is a substantial improvement over prior art composites and over composites with conventional polymer technology.

TABLE 11

Property	Instrument	Method
Tensile properties	Instron	D 3039
Flexural properties	Instron	D 790
Impact strength	Gardener	D 4226
Heat Distortion Temp	Aspen hot air oven	
Rheological	RDA	
Density	Pycnometer	

1. A weatherable, mechanically stable thin walled composite hollow profile comprising, a composite comprising: (a) greater than about 25 wt % of a polyolefin polymer composition having a melting point of about 145° C. to 158° C.; and (b) greater than about 50 to 75 wt % of a wood fiber, the fiber having a moisture content of less than 5000 parts of water per million parts of the profile, a particle size of about 100 to about 2000 μ m and an aspect ratio of about 1:2 to about 1:5; wherein the profile comprises an extruded complex hollow member having a defined support direction and a wall thickness of less than about 5 mm, the modulus of the profile is greater than about 5·10⁵ psi, the heat

distortion temperature of the profile in the defined support direction is greater than about 75° C. at 264 psi (ASTM D 696).

2. The profile of claim 1 wherein the polyolefin is a maleic anhydride grafted polypropylene and, with 1 to 100 moles of polypropylene, the modulus is at least about 8·10⁵ psi. 3. The profile of claim 1 wherein the polyolefin is polypropylene and the modulus is at least about 10·10⁵ psi. 4. The profile of claim 1 selected from the group consisting of a sill, a jamb, a stile, or a rail. 5. A unit comprising at least two profiles of claim 1 with a secure joint between the profiles. 6. The unit of claim 4 wherein the joint is formed by thermal welding. 7. The profile of claim 4 having a capstock layer with a thickness of about 0.05 to 1 mm. 8. The profile of claim 1 wherein the compatibilizer comprises a polyolefin having a molecular weight (M_w) of about 5000 to 100,000 and about 1 to 100 moles of maleic anhydride per mole of polymer. 9. The profile of claim 8 wherein the polyolefin is polypropylene. 10. The composite of claim 1 wherein the wood fiber comprises a moisture content of about 5 to 3200 ppm and a particle size of about 100 to 800 μ m and an aspect ratio of about 2 to 7. 11. The composite of claim 1 wherein the polymer has a weight average molecular weight (M_w) of about 20,000 to 80,000. 12. A mechanically stable and thermally stable polymer/fiber composite comprising:

(a) greater than about 25 wt % of a polyolefin polymer composition having a melt index of about 20 to 60 gm-10⁻¹, a melting point of about 145° C. to 158° C.; (b) greater than about 50 to 75 wt % of a wood fiber, the fiber having a moisture content of less than 5000 parts of water per million parts of the fiber, a particle size of about 100 to about 2000 μ m and an aspect ratio of about 1:2 to about 1:5; and (c) about 20 to 35 wt % of a polymer/fiber compatibilizer; wherein the modulus of the composite is greater than about 8·10⁵ psi, the compressive strength of the profile in the defined support direction is greater than about 1200 psi.

13. The profile of claim 12 wherein the compatibilizer comprises a polyolefin having a molecular weight (M_w) of about 5000 to 100,000 and about 1 to 100 moles of maleic anhydride per mole of polymer. 14. The composite of claim 12 having a modulus of at least about 10·10⁵ psi. 15. The composite of claim 12 having a modulus of at least about 12·10⁵ psi. 16. The composite of claim 12 wherein the wood fiber comprises a moisture content of about 1 to 5000 ppm and a particle size of about 100 to 2000 μ m and an aspect ratio of about 2 to 7. 17. The composite of claim 12 wherein the wood fiber comprises a moisture content of about 1 to 3500 ppm and a particle size of about 100 to 800 μ m and an aspect ratio of about 2 to 7. 18. The composite of claim 12 wherein the polymer is a polypropylene has a weight average molecular weight (M_w) of about 20,000 to 80,000.

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<i>DB=USPT,PGPB,JPAB,EPAB,DWPI,TDBD; PLUR=YES; OP=ADJ</i>			
<u>L5</u>	dodecylbenzenesulfonate near antistatic\$	4	<u>L5</u>
<u>L4</u>	dodecylbenzenesulfonate	9495	<u>L4</u>
<u>L3</u>	potassium alkane sulfonate near antistatic\$	0	<u>L3</u>
<u>L2</u>	potassium alkane sulfonate and (fiber or fibre)	0	<u>L2</u>
<u>L1</u>	potassium alkane sulfonate	4	<u>L1</u>

END OF SEARCH HISTORY

OTHER PUBLICATIONS

- "Composites of Wood and Polypropylenes I.", Hajime Kishi et al. *Mokuzai Gakkaishi*, 1988, vol. 34, No. 2, pp. 133-139.
- "Composites of Wood and Polypropylenes III.", Gyu-Seong Han et al., *Mokuzai Gakkaishi*, 1989, vol. 35, No. 12, pp. 1100-1104.
- "Properties of Blends of Starch and Synthetic Polymers Containing Anhydride Groups", Utpal R. Vaidya et al., *Journal of Applied Polymer Science*, 1994, vol. 52, pp. 617-628.
- "Composites of Polyvinyl Chloride-Wood Fibers. III: Effect of Silane as Coupling Agent", B. V. Kokta et al., *Journal of Vinyl Technology*, Sep. 1990, vol. 12, No. 3, pp. 146-153.
- "Composites of Poly(Vinyl Chloride-Wood Fibers: II: Effect of Chemical Treatment", B. V. Kokta et al., *Polymer Composites*, 1989.
- "Performance of Hybrid Reinforcements in PVC Composites: Part I—Use of Surface-Modified Mica and Wood Pulp as Reinforcements", Debesh Maldas et al., *Journal of Testing and Evaluation*, Jan. 1993, vol. 21, No. 1, pp. 68-72.
- Performance of Hybrid Reinforcements in PVC Composites: III. Use of Surface-Modified Glass Fiber and Wood Pulp as Reinforcements, D. Maldas et al., *Journal of Reinforced Plastics and Composites*, Oct. 1992, vol. II, pp. 1093-1102.
- "Surface modification of wood fibers using maleic anhydride and isocyanate as coating components and their performance in polystyrene composites", D. Maldas et al., *J. Adhesion Sci. Technol.*, 1991, vol. 0, No. 0, pp. 1-14.
- "PMSE—Polymeric Materials Science and Engineering". Spring Meeting 1992, San Francisco, CA. Proceedings of the American Chemical Society, Division of Polymeric Materials: Science and Engineering, vol. 66.

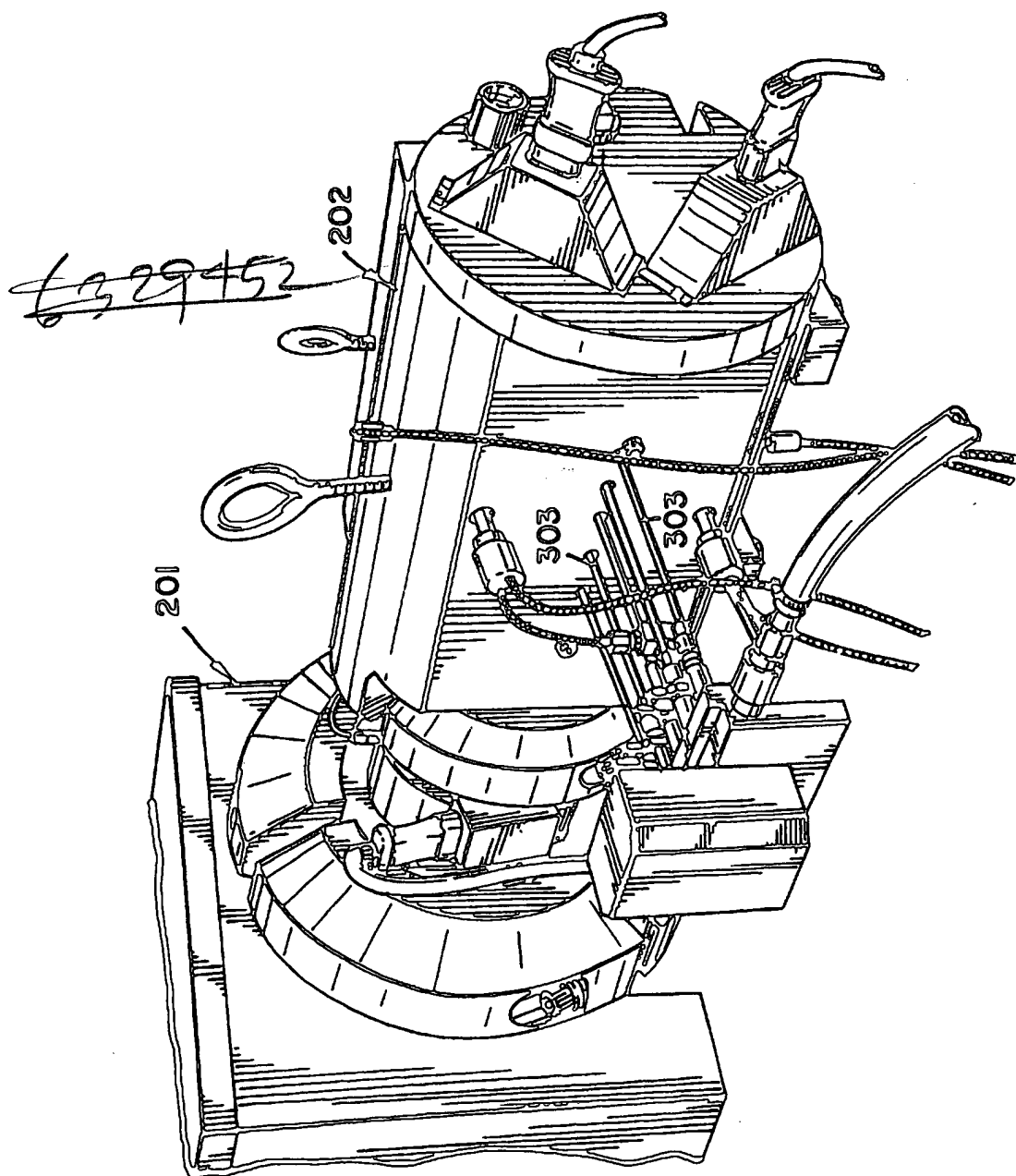
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DB=USPT,PGPB,JPAB,EPAB,DWPI,TDBD; PLUR=YES; OP=ADJ

<u>L23</u>	(modified silicone near lubricant) same (fibre or fiber)	2	<u>L23</u>
<u>L22</u>	modified silicone near lubricant	22	<u>L22</u>
<u>L21</u>	modified silicone	8484	<u>L21</u>
<u>L20</u>	(N,N-dimethyl formamide or N,N-dimethyl acetamide) same (spin\$4 near4 solvent)	7	<u>L20</u>
<u>L19</u>	(N,N-dimethyl formamide or N,N-dimethyl acetamide) near5 (spin\$4 near4 solvent)	4	<u>L19</u>
<u>L18</u>	(N,N-dimethyl formamide or N,N-dimethyl acetamide) near (spin\$4 near solvent)	4	<u>L18</u>
<u>L17</u>	(N,N-dimethyl formamide or N,N-dimethyl acetamide) near solvent and antistatic (fiber or fibre)	0	<u>L17</u>
<u>L16</u>	(N,N-dimethyl formamide or N,N-dimethyl acetamide) near solvent and polyurethane (fiber or fibre)	0	<u>L16</u>
<u>L15</u>	(N,N-dimethyl formamide or N,N-dimethyl acetamide) near solvent and elastic (fiber or fibre)	0	<u>L15</u>
<u>L14</u>	(N,N-dimethyl formamide or N,N-dimethyl acetamide) near solvent and (fiber or fibre)	112	<u>L14</u>
<u>L13</u>	(N,N-dimethyl formamide or N,N-dimethyl acetamide) near (spin\$4 solvent)	4	<u>L13</u>
<u>L12</u>	(N,N-dimethyl formamide or N,N-dimethyl acetamide) near solvent	353	<u>L12</u>
<u>L11</u>	(N,N-dimethyl formamide or N,N-dimethyl acetamide)	3784	<u>L11</u>
<u>L10</u>	(dimethyl formamide or dimethyl acetamide)	30586	<u>L10</u>
<u>L9</u>	(sulfonate or sulfate or phosphate) same (polytetramethylene glycol or polyesterdiol) same (fiber or fibre)	12	<u>L9</u>
<u>L8</u>	(sulfonate or sulfate or phosphate) near (polytetramethylene glycol or polyesterdiol) and (fiber or fibre)	0	<u>L8</u>
<u>L7</u>	(sulfonate or sulfate or phosphate) same (polytetramethylene glycol or polyesterdiol) and (fiber or fibre)	66	<u>L7</u>
<u>L6</u>	(sulfonate or sulfate or phosphate) near2 (polytetramethylene glycol or polyesterdiol)	6	<u>L6</u>
<u>L5</u>	(sulfonate or sulfate or phosphate) near1 (polytetramethylene glycol or polyesterdiol)	3	<u>L5</u>
<u>L4</u>	(sulfonate or sulfate or phosphate) near3 (polytetramethylene glycol or polyesterdiol)	9	<u>L4</u>
<u>L3</u>	(sulfonate or sulfate or phosphate) near11 (polytetramethylene glycol or polyesterdiol)	24	<u>L3</u>
<u>L2</u>	(sulfonate or sulfate or phosphate) near (polytetramethylene glycol or polyesterdiol)	3	<u>L2</u>

FIG. 5

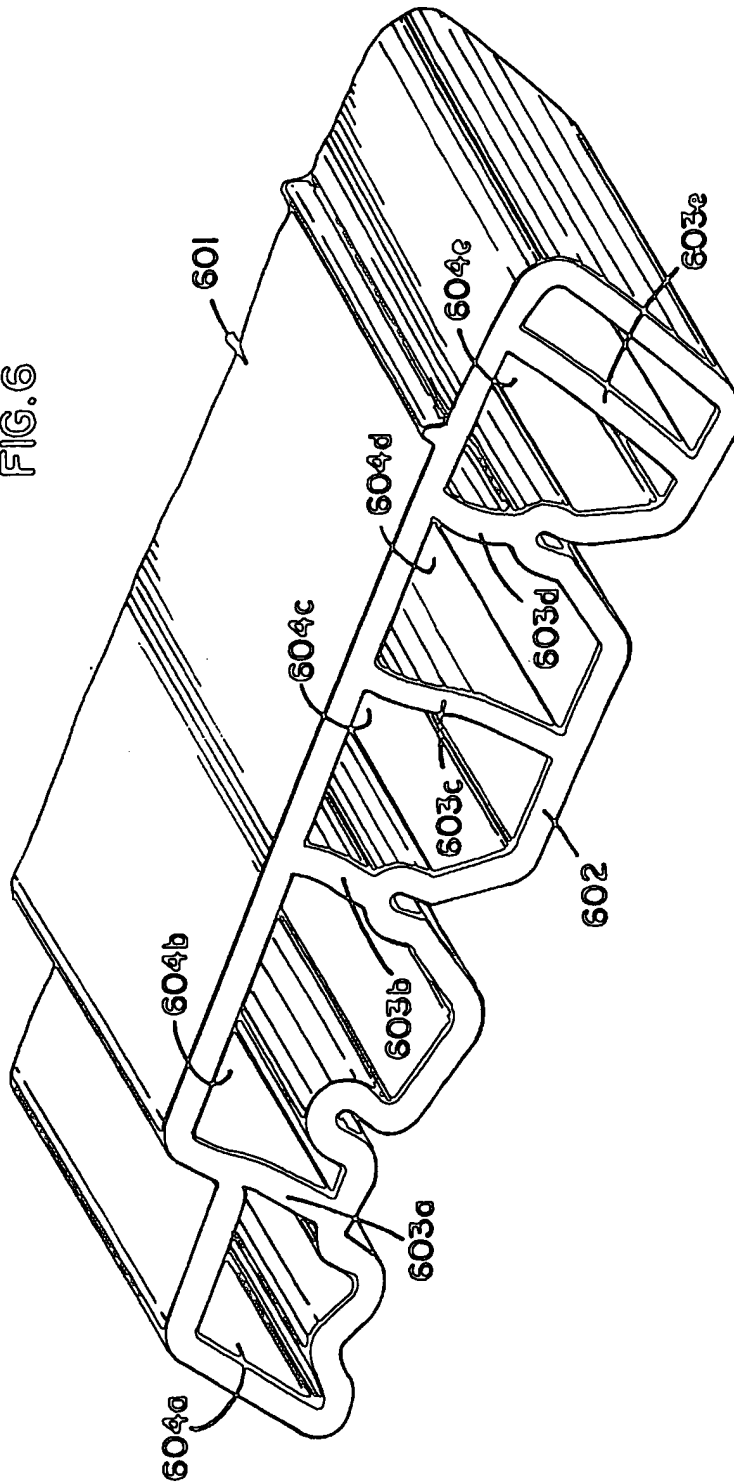


L1 (sulfonate or sulfate or phosphate) same (polytetramethylene glycol
or polyesterdiol)

152 L1

END OF SEARCH HISTORY

FIG. 6



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DB=USPT,PGPB,JPAB,EPAB,DWPI,TDBD; PLUR=YES; OP=ADJ

<u>L17</u>	(N,N-dimethyl formamide or N,N-dimethyl acetamide) near solvent and antistatic (fiber or fibre)	0	<u>L17</u>
<u>L16</u>	(N,N-dimethyl formamide or N,N-dimethyl acetamide) near solvent and polyurethane (fiber or fibre)	0	<u>L16</u>
<u>L15</u>	(N,N-dimethyl formamide or N,N-dimethyl acetamide) near solvent and elastic (fiber or fibre)	0	<u>L15</u>
<u>L14</u>	(N,N-dimethyl formamide or N,N-dimethyl acetamide) near solvent and (fiber or fibre)	112	<u>L14</u>
<u>L13</u>	(N,N-dimethyl formamide or N,N-dimethyl acetamide) near (spin\$4 solvent)	4	<u>L13</u>
<u>L12</u>	(N,N-dimethyl formamide or N,N-dimethyl acetamide) near solvent	353	<u>L12</u>
<u>L11</u>	(N,N-dimethyl formamide or N,N-dimethyl acetamide)	3784	<u>L11</u> ←
<u>L10</u>	(dimethyl formamide or dimethyl acetamide)	30586	<u>L10</u>
<u>L9</u>	(sulfonate or sulfate or phosphate) same (polytetramethylene glycol or polyesterdiol) same (fiber or fibre)	12	<u>L9</u>
<u>L8</u>	(sulfonate or sulfate or phosphate) near (polytetramethylene glycol or polyesterdiol) and (fiber or fibre)	0	<u>L8</u>
<u>L7</u>	(sulfonate or sulfate or phosphate) same (polytetramethylene glycol or polyesterdiol) and (fiber or fibre)	66	<u>L7</u>
<u>L6</u>	(sulfonate or sulfate or phosphate) near2 (polytetramethylene glycol or polyesterdiol)	6	<u>L6</u>
<u>L5</u>	(sulfonate or sulfate or phosphate) near1 (polytetramethylene glycol or polyesterdiol)	3	<u>L5</u>
<u>L4</u>	(sulfonate or sulfate or phosphate) near3 (polytetramethylene glycol or polyesterdiol)	9	<u>L4</u>
<u>L3</u>	(sulfonate or sulfate or phosphate) near1 1 (polytetramethylene glycol or polyesterdiol)	24	<u>L3</u>
<u>L2</u>	(sulfonate or sulfate or phosphate) near (polytetramethylene glycol or polyesterdiol)	3	<u>L2</u>
<u>L1</u>	(sulfonate or sulfate or phosphate) same (polytetramethylene glycol or polyesterdiol)	152	<u>L1</u>

END OF SEARCH HISTORY

forms a discontinuous phase suspended or dispersed throughout the polymer phase. The manufacture of the dispersed fiber phase within a continuous polymer phase requires substantial mechanical input. Such input can be achieved using a variety of mixing means including preferably extruder mechanisms wherein the materials are mixed under conditions of high shear until the appropriate degree of wetting and intimate contact is achieved. After the materials are fully mixed, the moisture content can be controlled at a moisture removal station. The heated composite is exposed to atmospheric pressure or reduced pressure at elevated temperature for a sufficient period of time to remove moisture resulting in a final moisture content of about 8 wt % or less. Lastly, the polymer fiber is aligned and extruded into a useful form.

The preferred equipment for mixing and extruding the composition and wood pellet of the invention is an industrial extruder device. Such extruders can be obtained from a variety of manufacturers including Cincinnati Millicron, etc.

The materials feed to the extruder can comprise from about 30 to 50 wt % of sawdust including recycled impurity along with the balance an engineering resin composition. Preferably, about 35 to 50 wt % wood fiber or sawdust is combined with 65 to 50 wt % of resin. The resin feed is commonly in a small particulate size which can take the form of flake, pellet, powder, etc. Any polymer resin form can be used such that the polymer can be dry mixed with the sawdust to result in a substantially uniform pre-mix. The wood fiber or sawdust input can be derived from a number of plant locations including the sawdust resulting from rip or cross grain sawing, milling of wood products or the intentional commuting or fiber manufacture from waste wood scrap. Such materials can be used directly from the operations resulting in the wood fiber by-product or the by-products can be blended to form a blended product. Further, any wood fiber material alone, or in combination with other wood fiber materials, can be blended with waste stream by-product from the manufacturer of wood windows as discussed above. The wood fiber or sawdust can be combined with other fibers and recycled in commonly available particulate handling equipment.

Resin and wood fiber are then dry blended in appropriate proportions prior to introduction into blending equipment. Such blending steps can occur in separate powder handling equipment or the polymer fiber streams can be simultaneously introduced into the mixing station at appropriate feed ratios to ensure appropriate product composition.

In a preferred mode, the wood fiber is placed in a hopper, controlled by weight or by volume, to proportion fiber into the mixer. The resin is introduced into a similar resin input system. The amount of resin and fiber are adjusted to ensure that the composite material contains appropriate proportions on a weight or volume basis. The fibers are introduced into an extrusion device preferably a twin screw extrusion device. The extrusion device has a mixing section, a transport section and melt section. Each section has a desired heat profile resulting in a useful product. The materials are introduced into the extruder at a rate of about 600 to about 1000 pounds of material per hour and are initially heated to a temperature that can maintain an efficient melt flow of resin. A multistage device is used that profiles processing temperature to efficiently combine resin and fiber. The final stage of extrusion comprises a head section. The head sections can contain a circular distribution (6-8" diameter) of 10 to 500 or more, preferably 20 to 250 orifices having a cross-sectional shape leading to the production of a regular cylindrical pellet. As the material is extruded from the head

it is cut with a double-ended knife blade at a rotational speed of about 100 to 400 rpm resulting in the desired pellet length.

The following examples were performed to further illustrate the invention that is explained in detail above. The following information illustrates the typical production conditions and compositions and the tensile modulus of a structural member made from the pellet. The following examples and data contain a best mode.

Sample Preparation

A laboratory scale twin screw Brabender extruder is used to prepare samples of engineering resin-sawdust composites. The following resins were used:

Brand Name	Generic Name	MFR. gm/10 min.*	Viscosity, Poise
Norril PPO N190X	Poly phenylene oxide	5-10	1050 @ 265° C.
Valox PBT 357	Poly butylene terephthalate		800-1300 @ 265° C.
Centrex ASA	Acrylonitrile styrene	0.8-5	
Monsanto 833	acrylate terpolymer		
ABS + PC Cycloloy 2950	ABS terpolymer polycarbonate blend	1-5	
Lustran ABS	Acrylonitrile	0.9-5	
Monsanto 633	butadiene styrene terpolymer		
Tyrel SAN Dow 1000	Styrene acrylonitrile	3.5-20 (lb/10 min. 0.002-0.03)	
CAB Eastman	Polyacetal Cellulose acetate butyrate	Flow Temp 180° C., Melt Flow not reported	
Geon PVC	Polyvinyl chloride	0.8-25	

*Melt index/melt flow rate as measured by ASTM 1238

These polymers are premixed with sawdust (40% by weight) in a dough mixer. To assist processability a lubricant, oxidized polyethylene AC 629A, is added at 1.5-2 phr (parts per hundred parts of resin). For example: 600 grams of polymer is mixed with 400 grams of sawdust and 9 grams of AC629A. The premixed polymer-sawdust is then fed into the lab extruder. The extruder is equipped with a slit die (1" width, 0.1" thick) and a take-off puller with an air knife for cooling.

The polymer-sawdust mixture is fed to the extruder with a volumetric feeder. The feed rate is adjusted to give a smooth flow of material. The extruder is run at the following conditions:

PARAMETER	SETTING
Barrel Zone 1 Temperature	150° C.
Barrel Zone 2 Temperature	165° C.
Barrel Zone 2 Temperature	180° C.
Adapter Temperature	185° C.
Die Temperature	180° C.
Screw Speed	10-15
Feeder setting	15-20
Air pressure for cooling	20 Psi

The temperatures, feed rates and the screw speeds are adjusted to accommodate the varying flow characteristics of different polymers. After extrusion, about 4 feet length of strips were saved for physical property testing.

Physical Property Testing

The following tests were conducted on the samples obtained from the extruded strips. The sample size for the

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<u>L9</u>	(sulfonate or sulfate or phosphate) same (polytetramethylene glycol or polyesterdiol) same (fiber or fibre)	12	<u>L9</u>
<u>L8</u>	(sulfonate or sulfate or phosphate) near (polytetramethylene glycol or polyesterdiol) and (fiber or fibre)	0	<u>L8</u>
<u>L7</u>	(sulfonate or sulfate or phosphate) same (polytetramethylene glycol or polyesterdiol) and (fiber or fibre)	66	<u>L7</u>
<u>L6</u>	(sulfonate or sulfate or phosphate) near2 (polytetramethylene glycol or polyesterdiol)	6	<u>L6</u>
<u>L5</u>	(sulfonate or sulfate or phosphate) near1 (polytetramethylene glycol or polyesterdiol)	3	<u>L5</u>
<u>L4</u>	(sulfonate or sulfate or phosphate) near3 (polytetramethylene glycol or polyesterdiol)	9	<u>L4</u>
<u>L3</u>	(sulfonate or sulfate or phosphate) near1 1 (polytetramethylene glycol or polyesterdiol)	24	<u>L3</u>
<u>L2</u>	(sulfonate or sulfate or phosphate) near (polytetramethylene glycol or polyesterdiol)	3	<u>L2</u>
<u>L1</u>	(sulfonate or sulfate or phosphate) same (polytetramethylene glycol or polyesterdiol)	152	<u>L1</u>

END OF SEARCH HISTORY

We have found that the interaction, on a microscopic level, between the resin mass and the wood fiber is an important element of the invention. The physical properties of an extruded member are improved when the polymer melt during extrusion of the pellet or linear member thoroughly wets and penetrates the wood fiber particles. The thermoplastic material comprises an exterior continuous organic resin phase with the wood particle dispersed as a discontinuous phase in the continuous resin phase. The fiber material during mixing and extrusion obtains or retains an aspect ratio of at least 1.5 and preferably between 2 and 7, optimizes orientation such as at least 20 wt %, preferably 30% of the fibers are oriented in an extruder direction and are thoroughly mixed and wetted by the polymer such that all exterior surfaces of the wood fiber are in contact with the polymer material. This means, that any pore, crevice, crack, passage way, indentation, etc., is fully filled by thermoplastic material. Such penetration as attained by ensuring that the viscosity of the resin melt is reduced by operations at elevated temperature and the use of sufficient pressure to force the polymer into the available internal pores, cracks and crevices in and on the surface of the wood fiber.

During the pellet or linear extrudate manufacture, substantial work is done in providing a uniform dispersion of the wood into the polymer material. Such work produces substantial orientation which when extruded into a final structural member, permits the orientation of the fibers in the structural member to be increased in the extruder direction resulting in improved structural properties.

The pellet dimensions are selected for both convenience in manufacturing and in optimizing the final properties of the extruded materials. A pellet is with dimensions substantially less than the dimensions set forth above are difficult to extrude, pelletize and handle in storage. Pellets larger than the range recited are difficult to introduce into extrusion or injection molding equipment, and are different to melt and form into a finished structural member.

Engineering Resin Thermoplastic Polymer, Copolymers and Polymeric Alloys

A large variety of engineering resins can be used in the pellet and the composite materials of the invention. For the purpose of this application, an engineering resin is a general term covering a thermoplastic that may or may not contain a filler or reinforcing material that have mechanical, chemical and thermal properties suitable for use as structural components, machine components and chemical processing equipment components. We have found that the engineering resins useful in the invention include both condensation polymeric materials and vinyl polymeric materials. Included are both vinyl and condensation polymer resins, and alloys thereof, such as acrylonitrile-butadiene-styrene (ABS), polyacetyl resins, polyacrylic resins, fluorocarbon resins, nylon, phenoxy resins, polybutylene resins, polyarylether such as polyphenylether, polyphenylsulfide materials; polycarbonate materials, chlorinated polyether resins, polyether-sulfone resins, polyphenylene oxide resins, polysulfone resins, polyimide resins, thermoplastic urethane elastomers and many other resin materials. Vinyl polymers are typically manufactured by the polymerization of monomers having an ethylenically unsaturated olefinic group. Condensation polymer resins are typically prepared by a condensation polymerization reaction which is typically considered to be a stepwise chemical reaction in which two or more molecules combined, often but not necessarily accompanied by the separation of water or some other simple typically volatile substance. If a polymer is formed, the process is called polycondensation.

Important Polymer Characteristics

Not every engineering resin is useful in the wood fiber composite materials that we had mentioned. First the engineering resin must have a surface energy such that the material is compatible with the wood fiber. Resins that are not compatible with the wood fiber will not sufficiently wet the wood fiber to intimately bond and penetrate the wood fiber to obtain sufficient engineering properties. For the purpose of this invention, surface energy or surface wettability is defined in ASTM D 724-89 as revised and explained in the paper Owens et al. "Estimation of the Surface Free Energy of Polymers," *Journal of Applied Polymer Science*, Vol. 13 pp. 1741-1747 (1969). This method has become a standard method for quantifying surface energy. We have found that a useful surface energy is greater than about 40 dynes per centimeter. Further, we have found that the engineering resin must have sufficient viscosity at processing temperatures substantially less than the decomposition temperature of wood fiber. Accordingly, the processing temperature of the thermoplastic material must be substantially less than about 450° F. (340° C.) preferably between 180 and 240° C. Further, we have found that the engineering resin used in the composite of the invention must have little or no moisture sensitivity. In other words, when processed at thermoplastic temperatures, the resin as a result of instability in the presence of moisture, does not substantially change its molecular weight or melt index. A substantial change in molecular weight or melt index is a 50% reduction in molecular weight or a doubling in melt index. Lastly, after the thermoplastic material is manufactured by combining the thermoplastic engineering resin and the wood fiber, the resulting composite has a modulus greater than about 500,000 psi, preferably at least 600,000 psi. Further, the composite material should have a two hour water absorption ASTM D-57-81 less than 2%, more preferably less than 1% most preferably less than 0.6%.

ENGINEERING RESIN THERMOPLASTIC PARAMETERS

	USEFUL	PREFERRED
PROCESS TEMPERATURE	T <250° C.	150°-240° C.
MOISTURE SENSITIVITY	Less than 4x increase in MI	Less than 2x increase in MI
SURFACE ENERGY	E >40 dynes/cm	E >45 dynes/cm
MODULUS* (RESIN)	>200,000	>300,000

*FLEX

Condensation Polymer Resins

Condensation polymer resins that can be used in the composite materials of the invention include polyamides, polyamide-imide polymers, polyarylsulfones, polycarbonate, polybutylene terephthalate, polybutylene naphthalate, polyetherimides, polyethersulfones, polyethylene terephthalate, thermoplastic polyimides, polyphenylene ether blends, polyphenylene sulfide, polysulfones, thermoplastic polyurethanes and others. Preferred condensation engineering resins include polycarbonate materials, polyphenyleneoxide materials, and polyester materials including polyethylene terephthalate, polybutylene terephthalate, polyethylene naphthalate and polybutylene naphthalate materials. Generally useful condensation polymers have a melt flow index of about 1 to 10 gm/10 min.

Polycarbonate engineering resins are high performance, amorphous engineering thermoplastics having high impact

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Search Results - Record(s) 1 through 12 of 12 returned.☐ 1. Document ID: US 20030035951 A1

L9: Entry 1 of 12

File: PGPB

Feb 20, 2003

PGPUB-DOCUMENT-NUMBER: 20030035951
PGPUB-FILING-TYPE: new
DOCUMENT-IDENTIFIER: US 20030035951 A1

TITLE: Multi-component fibers having enhanced reversible thermal properties and methods of manufacturing thereof

PUBLICATION-DATE: February 20, 2003

INVENTOR-INFORMATION:

NAME	CITY	STATE	COUNTRY	RULE-47
Magill, Monte C.	Longmont	CO	US	
Hartmann, Mark H.	Superior	CO	US	
Haggard, Jeffrey S.	Cocoa	FL	US	

US-CL-CURRENT: 428/373; 264/177.13, 428/375

Full	Title	Citation	Front	Review	Classification	Date	Reference	Sequences	Attachments	Claims	ENC
Draw Desc	Image										

☐ 2. Document ID: US 6045700 A

L9: Entry 2 of 12

File: USPT

Apr 4, 2000

US-PAT-NO: 6045700
DOCUMENT-IDENTIFIER: US 6045700 A
**** See image for Certificate of Correction ****

TITLE: Retrievable organic carbon scavengers for cleaning of contaminated surface water sediments

DATE-ISSUED: April 4, 2000

INVENTOR-INFORMATION:

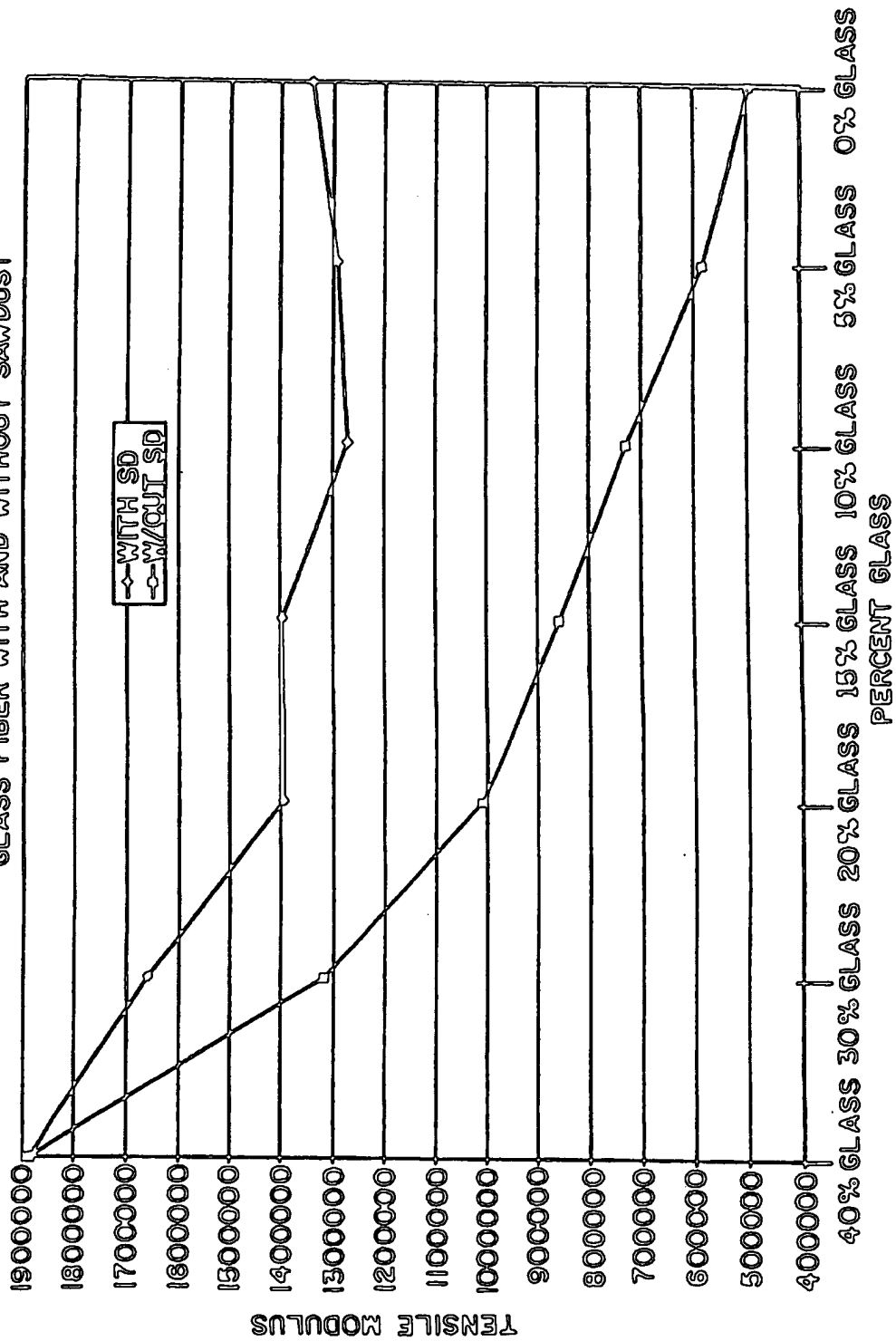
NAME	CITY	STATE	ZIP CODE	COUNTRY
Heitkamp; Michael A.	Ballwin	MO		
Kimerle; Richard A.	St. Louis	MO		

US-CL-CURRENT: 210/638; 210/670, 210/692, 210/694, 210/747

Full	Title	Citation	Front	Review	Classification	Date	Reference	Sequences	Attachments	Claims	ENC
Draw Desc	Image										

FIG. 2

MODULUS COMPARISON
GLASS FIBER WITH AND WITHOUT SAWDUST



☐ 3. Document ID: US 5858528 A

L9: Entry 3 of 12

File: USPT

Jan 12, 1999

US-PAT-NO: 5858528

DOCUMENT-IDENTIFIER: US 5858528 A

TITLE: Heat-bonding conjugated fibers and highly elastic fiber balls comprising the same

DATE-ISSUED: January 12, 1999

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Tashiro; Mikio	Matsuyama			JP
Hirano; Shigeru	Matsuyama			JP
Hayashi; Masayuki	Matsuyama			JP
Orii; Kazunori	Osaka			JP
Yoshida; Makoto	Ibaraki			JP

US-CL-CURRENT: 428/357; 428/374

Full	Title	Citation	Front	Review	Classification	Date	Reference	Sequences	Attachments	RMK
Draw Desc	Image									

☐ 4. Document ID: US 5677057 A

L9: Entry 4 of 12

File: USPT

Oct 14, 1997

US-PAT-NO: 5677057

DOCUMENT-IDENTIFIER: US 5677057 A

**** See image for Certificate of Correction ****

TITLE: Heat-bonding conjugated fibers and highly elastic fiber balls comprising the same

DATE-ISSUED: October 14, 1997

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Tashiro; Mikio	Matsuyama			JP
Hirano; Shigeru	Matsuyama			JP
Hayashi; Masayuki	Matsuyama			JP
Orii; Kazunori	Osaka			JP
Yoshida; Makoto	Osaka			JP

US-CL-CURRENT: 428/374; 428/397

Full	Title	Citation	Front	Review	Classification	Date	Reference	Sequences	Attachments	RMK
Draw Desc	Image									

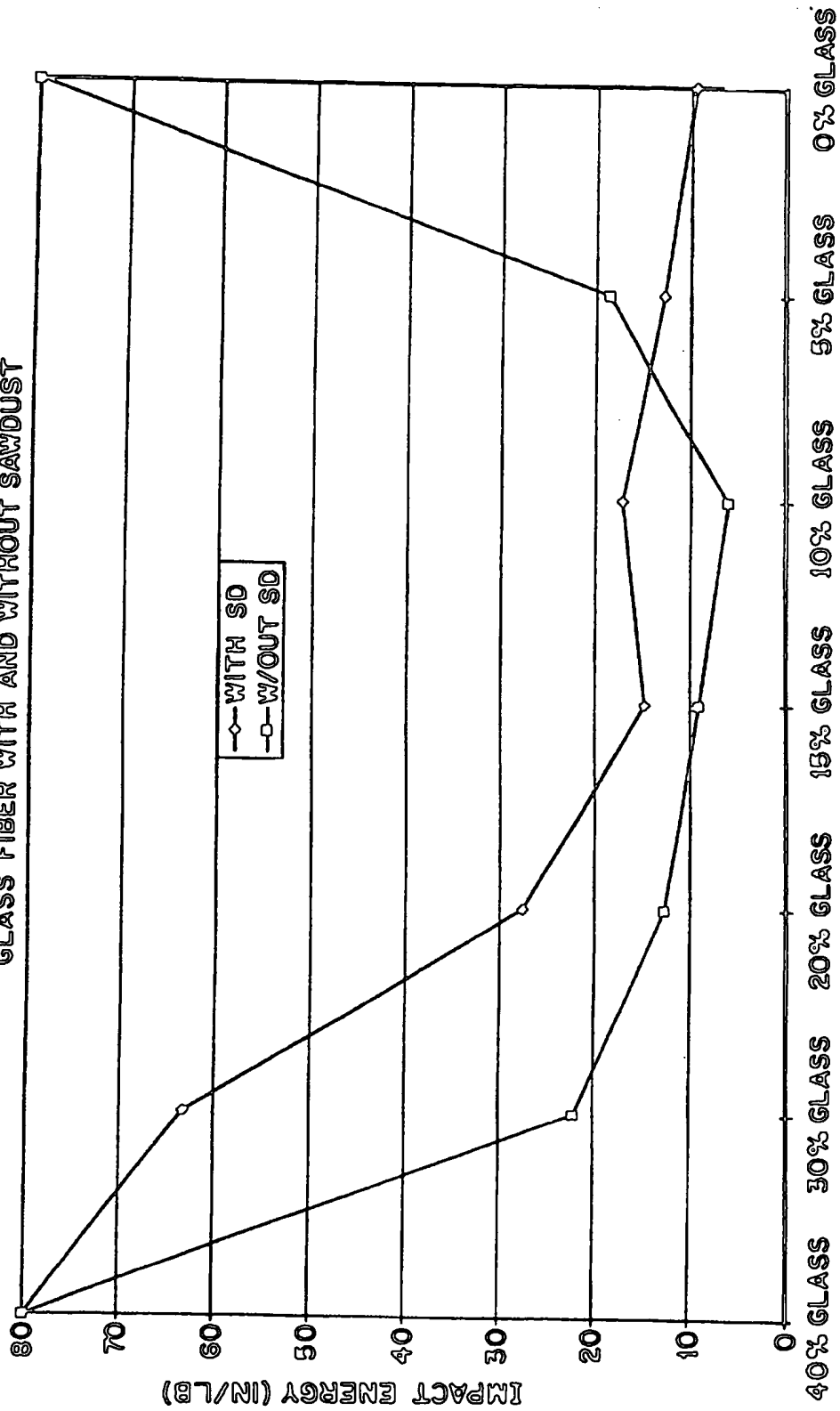
☐ 5. Document ID: US 4940560 A

L9: Entry 5 of 12

File: USPT

Jul 10, 1990

FIG. 3
IMPACT ENERGY COMPARISON
GLASS FIBER WITH AND WITHOUT SAWDUST



US-PAT-NO: 4940560

DOCUMENT-IDENTIFIER: US 4940560 A

TITLE: Process for preparing antistatic fiber

DATE-ISSUED: July 10, 1990

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Shizuki; Tatsuhiko	Otsu			JP
Ban; Kaoru	Otsu			JP
Yoshida; Fumikazu	Otsu			JP
Ohguchi; Masakatsu	Otsu			JP

US-CL-CURRENT: 264/211; 264/176.1, 264/184, 264/211.14, 264/232, 264/340, 8/115.54

Full	Title	Citation	Front	Review	Classification	Date	Reference	Sequences	Attachments	NAME
Draw Desc	Image									

☐ 6. Document ID: US 4600743 A

L9: Entry 6 of 12

File: USPT

Jul 15, 1986

US-PAT-NO: 4600743

DOCUMENT-IDENTIFIER: US 4600743 A

TITLE: Antistatic fiber containing polyoxyalkylene glycol

DATE-ISSUED: July 15, 1986

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Shizuki; Tatsuhiko	Otsu			JP
Ban; Kaoru	Otsu			JP
Yoshida; Fumikazu	Otsu			JP
Ohguchi; Masakatsu	Otsu			JP

US-CL-CURRENT: 524/377; 264/177.13, 524/599, 524/601, 524/604, 524/605, 524/606

Full	Title	Citation	Front	Review	Classification	Date	Reference	Sequences	Attachments	NAME
Draw Desc	Image									

☐ 7. Document ID: JP 10037075 A

L9: Entry 7 of 12

File: JPAB

Feb 10, 1998

PUB-NO: JP410037075A

DOCUMENT-IDENTIFIER: JP 10037075 A

TITLE: TREATING AGENT FOR LOWERING FRICTION OF SEATBELT

PUBN-DATE: February 10, 1998

INVENTOR-INFORMATION:

POLYMER FIBER COMPOSITE WITH MECHANICAL PROPERTIES ENHANCED BY PARTICLE SIZE DISTRIBUTION

RELATED APPLICATIONS

This application is a Continuation-in-Part application of Deaner et al., U.S. Ser. No. 08/224,396, filed Apr. 7, 1994, now abandoned which is a Continuation application of Deaner et al., U.S. Ser. No. 07/938,364, filed Aug. 31, 1992, now abandoned.

FIELD OF THE INVENTION

The invention relates to composite polymer/fiber thermoplastic materials used for the fabrication of structural members. Such a member can be any structural unit, but are preferably for use in windows and doors for residential and commercial architecture. These polymer/fiber composite materials include an fiber blend that provides optimal engineering properties. The composite can also contain an optional, intentional recycle of by-product streams, from window and door manufacture, of polymer, adhesive, paint, etc. More particularly, the invention relates to an improved composite material adapted to extrusion or injection molding processes for forming structural members that have improved properties when used in windows and doors. The composite materials of the invention can be made to manufacture structural components such as rails, jambs, stiles, sills, tracks, stop and sash, nonstructural trim elements such as grid, cove, bead, quarter round, etc.

BACKGROUND OF THE INVENTION

Conventional window and door manufacture has commonly used wood and metal components in forming structural members. Commonly, residential windows are manufactured from milled wood products that are assembled with glass to form typically double hung or casement units. Wood windows while structurally sound, useful and well adapted for use in many residential installations, can deteriorate under certain circumstances. Wood windows also require painting and other periodic maintenance. Wooden windows also suffer from cost problems related to the availability of suitable wood for construction. Clear wood products are slowly becoming more scarce and are becoming more expensive as demand increases. Metal components are often combined with glass and formed into single unit sliding windows. Metal windows typically suffer from substantial energy loss during winter months.

Extruded thermoplastic materials have been used in window and door manufacture. Filled and unfilled thermoplastics have been extruded into useful seals, trim, weatherstripping, coatings and other window construction components. Thermoplastic materials such as polyvinyl chloride have been combined with wood members in manufacturing PERMASHIELD® brand windows manufactured by Andersen Corporation for many years. The technology disclosed in Zanini, U.S. Pat. Nos. 2,926,729 and 3,432,883, have been utilized in the manufacturing of plastic coatings or envelopes on wooden or other structural members. Generally, the cladding or coating technology used in making PERMASHIELD® windows involves extruding a thin polyvinyl chloride coating or envelope surrounding a wooden structural member. Recent advances have made a polyvinyl chloride/cellulosic fiber composite material useful in the manufacture of structural members for windows and doors. Puppini et al., U.S. Pat. No. 5,406,768 comprise a continuous phase of polyvinyl chloride and a particular

wood fiber material having preferred fiber size and aspect ratio in a thermoplastic material that provides engineering properties for structural members and for applications in window and door manufacture. These thermoplastic composite materials have become an important part of commercial manufacture of window and door components. While these materials are sufficiently strong for most structural components used in window and door manufacture, certain components require added stiffness, tensile strength, elongation at break or other engineering property not always provided by the materials disclosed in Puppini et al.

Polyvinyl chloride has been combined with wood fiber to make extruded materials. However, such materials have not successfully been used in the form of a structural member that is a direct replacement for wood. Common thermoplastic composite materials cannot provide similar thermal and structural properties to wood. These extruded materials fail to have sufficient modulus, compressive strength, coefficient of thermal expansion that matches wood to produce a direct replacement material. Further, many prior art extruded composites must be milled after extrusion to a final useful shape. Typical commodity thermoplastic compositions have achieved a modulus no greater than about 500,000. One class of composite, a polyvinyl chloride/wood flour material, poses the added problem that wood dust, which can accumulate during manufacture, tends to be explosive at certain concentrations of wood flour in the air. Most commonly, poly vinyl chloride, polystyrene and polyethylene thermoplastics have been used in such products. The prior art has used a various fiber having a large distribution of fiber sizes. No attention has been given to the improvement of engineering properties using a novel distribution of fiber sizes.

Accordingly, a substantial need exists for a composite material that can be made of polymer and fiber. The improved fiber can contain an optional, intentional recycle of a waste stream. A further need exists for a composite material that can be extruded into a shape that is a direct substitute for the equivalent milled shape in a wooden or metal structural member. This need requires a coefficient of thermal expansion that approximates wood, a material that can be extruded into reproducible stable dimensions, a high compressive strength, a low thermal transmission rate, an improved resistance to insect attack and rot while in use and a hardness and rigidity that permits sawing, milling, and fastening retention comparable to wood members.

BRIEF DISCUSSION OF THE INVENTION

We have found that an improved substitute for composite, wood and metal structural members and the problems relating to the recycle of waste streams in window manufacture can be solved by forming a polymer/fiber composite material into window and door structural members. We have found a threshold level of addition of high aspect ratio first fiber to short aspect ratio second fiber in a PVC composite that produces enhanced properties. The blend of long or high aspect ratio fiber and short aspect ratio fiber produces a substantial increase in tensile modulus and also improves impact energy for composites. Such improved physical properties increase the utility of such materials and the manufacture of structural members used in window and door manufacture for institutional, commercial or residential construction. Importantly, we have found that the dimensions of the discontinuous fiber in the fiber phase of a polymer fiber composite has an important impact on engineering properties.

Additionally, the use of different types of fiber having varied fiber particle sizes also has an important impact on

NAME

COUNTRY

NAGAHARA, HIDEO

TERASAWA, HIROYUKI

SAITO, ISOO

INT-CL (IPC): D06 M 15/53; B60 R 22/12

Full	Title	Citation	Front	Review	Classification	Date	Reference	Sequences	Attachments
Draw Desc	Image								

RMC



8. Document ID: JP 09291418 A

L9: Entry 8 of 12

File: DWPI

Nov 11, 1997

DERWENT-ACC-NO: 1998-037339

DERWENT-WEEK: 199804

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TITLE: Polyester fibre for forming engraved pattern - comprises copolymer obtained from isophthalic acid component containing repeating ethylene terephthalate unit and metal sulphonate group, and poly:alkylene glycol

PRIORITY-DATA: 1996JP-0099855 (April 22, 1996)

PATENT-FAMILY:

PUB-NO	PUB-DATE	LANGUAGE	PAGES	MAIN-IPC
JP 09291418 A	November 11, 1997		004	D01F006/84

INT-CL (IPC): D01 F 6/84; D01 F 6/86; D06 M 11/32

Full	Title	Citation	Front	Review	Classification	Date	Reference	Sequences	Attachments
Draw Desc	Image								

RMC



9. Document ID: JP 04275368 A

L9: Entry 9 of 12

File: DWPI

Sep 30, 1992

DERWENT-ACC-NO: 1992-376350

DERWENT-WEEK: 199246

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TITLE: Polyphenylene sulphide resin compsn. with improved adhesion to epoxy resin - obtd. by compounding polyphenylene sulphide resin, fibrous and/or non-fibrous filler, and poly:alkylene ether cpd.

PRIORITY-DATA: 1991JP-0036230 (March 1, 1991)

PATENT-FAMILY:

PUB-NO	PUB-DATE	LANGUAGE	PAGES	MAIN-IPC
JP 04275368 A	September 30, 1992		007	C08L081/02

INT-CL (IPC): C08K 3/00; C08K 7/02; C08L 81/02; C08L 71/02; C08L 81/02

Full	Title	Citation	Front	Review	Classification	Date	Reference	Sequences	Attachments
Draw Desc	Clip Img	Image							

RMC

causes overlapping of adjacent parallel fibers and polymeric coating of the oriented fibers resulting a material useful for manufacture of improved structural members with improved physical properties. The degree of orientation is about 20%, preferably 30% above random orientation which is about 45 to 50%. The structural members have substantially increased strength and tensile modulus with a coefficient of thermal expansion and a modulus of elasticity that is optimized for window and doors. The properties are a useful compromise between wood, aluminum and neat polymer.

Moisture control is an important element of manufacturing a useful linear extrudate or pellet. Depending on the equipment used and processing conditions, control of the water content of the linear extrudate or pellet can be important in forming a successful structural member substantially free of internal voids or surface blemishes. The concentration of water present in the sawdust during the formation of pellet or linear extrudate when heated can flash from the surface of the newly extruded structural member and can come as a result of a rapid volatilization, form a steam bubble deep in the interior of the extruded member which can pass from the interior through the hot thermoplastic extrudate leaving a substantial flaw. In a similar fashion, surface water can bubble and leave cracks, bubbles or other surface flaws in the extruded member.

Trees when cut depending on relative humidity and season can contain from 30 to 300 wt-% water based on fiber content. After rough cutting and finishing into sized lumber, seasoned wood can have a water content of from 20 to 30 wt-% based on fiber content. Kiln dried sized lumber cut to length can have a water content typically in the range of 8 to 12%, commonly 8 to 10 wt-% based on fiber. Some wood source, such as poplar or aspen, can have increased moisture content while some hard woods can have reduced water content.

Because of the variation in water content of wood fiber source and the sensitivity of extrudate to water content control of water to a level of less than 8 wt-% in the pellet based on pellet weight is important. Structural members extruded in non-vented extrusion process, the pellet should be as dry as possible and have a water content between 0.01 and 5%, preferably less than 3.5 wt-%. When using vented equipment in manufacturing the extruded linear member, a water content of less than 8 wt-% can be tolerated if processing conditions are such that vented extrusion equipment can dry the thermoplastic material prior to the final formation of the structural member of the extrusion head.

The pellets or linear extrudate of the invention are made by extrusion of the polymer and fiber composite through an extrusion die resulting in a linear extrudate that can be cut into a pellet shape. The pellet cross-section can be any arbitrary shape depending on the extrusion die geometry. However, we have found that a regular geometric cross-sectional shape can be useful. Such regular cross-sectional shapes include a triangle, a square, a rectangle, a hexagonal, an oval, a circle, etc. The preferred shape of the pellet is a regular cylinder having a roughly circular or somewhat oval cross-section. The pellet volume is preferably greater than about 12 mm³. The preferred pellet is a right circular cylinder, the preferred radius of the cylinder is at least 1.5 mm with a length of at least 1 mm. Preferably, the pellet has a radius of 1 to 5 mm and a length of 1 to 10 mm. Most preferably, the cylinder has a radius of 2.3 to 2.6 mm, a length of 2.4 to 4.7 mm, a volume of 40 to 100 mm³, a weight of 40 to 130 mg and a bulk density of about 0.2 to 0.8 gm/mm³.

We have found that the interaction, on a microscopic level, between the polymer mass and the fiber is an impor-

tant element of the invention. We have found that the physical properties of an extruded member are improved when the polymer melt during extrusion of the pellet or linear member thoroughly wets and penetrates or amounts with the fiber particles. The thermoplastic material comprises an exterior continuous organic polymer phase with the wood particle dispersed as a discontinuous phase in the continuous polymer phase. The material during mixing and extrusion obtains an aspect ratio of at least 1.1 and preferably between 2 and 4, optimizes orientation such as at least 20 wt-%, preferably 30% of the fibers are oriented in an extruder direction and are thoroughly mixed and wetted by the polymer such that all exterior surfaces of the wood fiber are in contact with the polymer material. This means, that any pore, crevice, crack, passage way, indentation, etc., is fully filled by thermoplastic material. Such penetration as attained by ensuring that the viscosity of the polymer melt is reduced by operations at elevated temperature and the use of sufficient pressure to force the polymer into the available internal pores, cracks and crevices in and on the surface of the wood fiber.

During the pellet or linear extrudate manufacture, substantial work is done in providing a uniform dispersion of the wood into the polymer material. Such work produces substantial orientation which when extruded into a final structural member, permits the orientation of the fibers in the structural member to be increased in the extruder direction resulting in improved structural properties.

The pellet dimensions are selected for both convenience in manufacturing and in optimizing the final properties of the extruded materials. A pellet is with dimensions substantially less than the dimensions set forth above are difficult to extrude, pelletize and handle in storage. Pellets larger than the range recited are difficult to introduce into extrusion or injection molding equipment, and are different to melt and form into a finished structural member.

Polymer Materials

Polymers that can be used for forming the polymer composites of the invention are commonly organic fiber-forming compositions that can be formed from a variety of common polymeric polymers including addition polymers, condensation polymers, natural polymers, treated polymers, thermosetting or thermoplastic resins.

Useful thermosetting resins include phenolic resins, phenol-aldehyde resins, furan resins, amino-plast resins, alkyd resins, allyl resins, epoxy resins, epoxy prepreps, polyurethane resins, thermosetting polyester resins, polyamide bis-maleimide resin, polymaleimide-epoxy resin, polymaleimide-isocyanate resin, silicone resins, cyanate resins, a cyanate-epoxy resins, a cyanate-polymaleimide resins, and a cyanate-epoxy-polymaleimide resin; thermosetting so-called "IPN" as obtained by compounding the above thermosetting resins and engineering plastics such as polyamide (Nylon), aromatic polyester, polyetherimide, polyetherether ketone, polysulfone, and polyphenyleneether, and further adding a catalyst; crosslinkable resins obtained by compounding an organic peroxide as a crosslinking agent and a radical polymerizable polyfunctional compound, a thermosetting resin and the like to resins. Because of the nature of thermosetting resins, they cannot be further heat processed without severe distortion or destruction.

Polyamide polymer can be used in the preferred polymer composite. Preferred polyimides are typically made by a two step reaction involving contacting a tetrabasic acid dianhydride with an aromatic diamine giving first a polyamic acid

☐ 10. Document ID: JP 63265609 A JP 93039173 B

L9: Entry 10 of 12

File: DWPI

Nov 2, 1988

DERWENT-ACC-NO: 1988-356253

DERWENT-WEEK: 198850

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TITLE: Reinforcement for polyurethane RIM products - comprises calcium sulphate short fibres surface-treated with silane coupling agent

PRIORITY-DATA: 1987JP-0100032 (April 24, 1987)

PATENT-FAMILY:

PUB-NO	PUB-DATE	LANGUAGE	PAGES	MAIN-IPC
JP 63265609 A	November 2, 1988		006	
JP 93039173 B	June 14, 1993		005	B29C045/00

INT-CL (IPC): B29C 39/00; B29C 45/00; B29K 75/00; B29K 75/00; B29K 105/12; B29K 105/12; B29L 31/30; B29L 31/30

Full	Title	Citation	Front	Review	Classification	Date	Reference	Sequences	Attachments	RMG
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☐ 11. Document ID: JP 60155769 A JP 91060948 B

L9: Entry 11 of 12

File: DWPI

Aug 15, 1985

DERWENT-ACC-NO: 1985-239650

DERWENT-WEEK: 198539

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TITLE: Imparting antipilling properties to polyester fibre - by dipping in aq. soln. contg. barium salt and alkaline cpd.

PRIORITY-DATA: 1984JP-0009273 (January 20, 1984)

PATENT-FAMILY:

PUB-NO	PUB-DATE	LANGUAGE	PAGES	MAIN-IPC
JP 60155769 A	August 15, 1985		004	
JP 91060948 B	September 18, 1991		000	

INT-CL (IPC): D06M 5/02; D06M 11/15; D06M 101/32

Full	Title	Citation	Front	Review	Classification	Date	Reference	Sequences	Attachments	RMG
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☐ 12. Document ID: JP 50101698 A JP 83028389 B

L9: Entry 12 of 12

File: DWPI

Aug 12, 1975

DERWENT-ACC-NO: 1976-10189X

DERWENT-WEEK: 197606

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TITLE: Fire- and waterproofing of polyester textiles - by treatmn with urethane elastomer and halo-phosphate ester and fluorine contg polymer

PRIORITY-DATA: 1974JP-0008543 (January 21, 1974)

which is then converted by heat or catalyst into a high molecular weight, linear polyamide.

Thermoplastic resins are also useful in the composite of the invention. Useful addition polymers include poly alpha-olefins, polyethylene, polypropylene, poly 4-methylpentene-1, ethylene/vinyl copolymers, ethylene vinyl acetate copolymers, ethylene acrylic acid copolymers, ethylene methacrylate copolymers, ethyl-methylacrylate copolymers, etc.; thermoplastic propylene polymers such as polypropylene, ethylene-propylene copolymers, etc.; vinyl chloride polymers and copolymers; vinylidene chloride polymers and copolymers; polyvinyl alcohols, acrylic polymers made from acrylic acid, methacrylic acid, methylacrylate, methacrylate, acrylamide and others. Fluorocarbon resins such as polytetrafluoroethylene, polyvinylidene fluoride, and fluorinated ethylene-propylene resins. Styrene resins such as a polystyrene, alpha-methylstyrene, high impact polystyrene acrylonitrile-butadiene-styrene polymers and others and reinforced materials obtained by compounding glass, carbon, alumina, other fibers, fiber cloth, powder and other fillers to the above polymers of these, those having a glass transition temperature of at least 160° F. are preferred. In particular, polymers having a glass transition temperature of at least 140° F. and preferably a T_g of 180° F. or more is preferred.

A variety of condensation polymers can also be used in the manufacture of the composites of the invention including nylon (polyamide) resins such as nylon 6, nylon 66, nylon 10, nylon 11, nylon 12, etc. A variety of polyester materials can be made from dibasic aliphatic and aromatic carboxylic acids and di or triols. Representative examples include polyethylene-terephthalate, polybutylene terephthalate and others.

Polycarbonates can also be used in the manufacture of the invention. Such polycarbonates are long chained linear polyesters of carbonic acid and dihydric phenols typically made by reacting phosgene (COCl_2) with bisphenol A materials resulting in transparent, tough, dimensionally stable plastics. A variety of other condensation polymers are used including polyetherimide, polysulfone, polyethersulfone, polybenzazoles, aromatic polysulfones, polyphenylene oxides, polyether ether ketone and others.

Preferred Polyvinyl Chloride Homopolymer, Copolymers and Polymeric Alloys

Polyvinyl chloride is a common commodity thermoplastic polymer. Vinyl chloride monomer is made from a variety of different processes such as the reaction of acetylene and hydrogen chloride and the direct chlorination of ethylene. Polyvinyl chloride is typically manufactured by the free radical polymerization of vinyl chloride monomer resulting in a useful thermoplastic polymer. After polymerization, polyvinyl chloride is commonly combined with thermal stabilizers, lubricants, plasticizers, organic and inorganic pigments, fillers, biocides, processing aids, flame retardants and other commonly available additive materials. Polyvinyl chloride can also be combined with other vinyl monomers in the manufacture of polyvinyl chloride copolymers. Such copolymers can be linear copolymers, branched copolymers, graft copolymers, random copolymers, regular repeating copolymers, block copolymers, etc. Monomers that can be combined with vinyl chloride to form vinyl chloride copolymers include a acrylonitrile; alpha-olefins such as ethylene, propylene, etc.; chlorinated monomers such as vinylidene chloride, chlorinated polyethylene, acrylate monomers such as acrylic acid, methylacrylate, methylmethacrylate,

acrylamide, hydroxyethyl acrylate, and others; styrenic monomers such as styrene, alphas-methyl styrene, vinyl toluene, etc.; vinyl acetate; and other commonly available ethylenically unsaturated monomer compositions.

Such monomers can be used in an amount of up to about 50 mol-%, the balance being vinyl chloride. Polymer blends or polymer alloys can be useful in manufacturing the pellet or linear extrudate of the invention. Such alloys typically comprise two miscible polymers blended to form a uniform composition. Scientific and commercial progress in the area of polymer blends has lead to the realization that important physical property improvements can be made not by developing new polymer material but by forming miscible polymer blends or alloys. A polymer alloy at equilibrium comprises a mixture of two amorphous polymers existing as a single phase of intimately mixed segments of the two macro molecular components. Miscible amorphous polymers form glasses upon sufficient cooling and a homogeneous or miscible polymer blend exhibits a single, composition dependent glass transition temperature (T_g). Immiscible or non-alloyed blend of polymers typically displays two or more glass transition temperatures associated with immiscible polymer phases. In the simplest cases, the properties of polymer alloys reflect a composition weighted average of properties possessed by the components. In general, however, the property dependence on composition varies in a complex way with a particular property, the nature of the components (glassy, rubbery or semi-crystalline), the thermodynamic state of the blend, and its mechanical state whether molecules and phases are oriented. Polyvinyl chloride forms a number of known polymer alloys including, for example, polyvinyl chloride/nitrile rubber; polyvinyl chloride and related chlorinated copolymers and terpolymers of polyvinyl chloride or vinylidene dichloride; polyvinyl chloride/alphamethyl styrene-acrylonitrile copolymer blends; polyvinyl chloride/polyethylene; polyvinyl chloride/chlorinated polyethylene and others.

The primary requirement for the substantially thermoplastic polymeric material is that it retain sufficient thermoplastic properties to permit melt blending with wood fiber, permit formation of linear extrudate pellets, and to permit the composition material or pellet to be extruded or injection molded in a thermoplastic process forming the rigid structural member. Polyvinyl chloride homopolymers copolymers and polymer alloys are available from a number of manufacturers including Geon, Vista, Air Products, Occidental Chemicals, etc. Preferred polyvinyl chloride materials are polyvinyl chloride homopolymer having a molecular weight (M_n) of about 90,000±50,000, most preferably about 88,000±10,000.

Short Fiber

The polymer fiber composite compounds of the invention preferably contains a blend of a collection of short fiber and a collection of long fiber. The term short fiber typically suggests the fiber with an aspect ratio of less than about 10, preferably less than 5. The short fiber has a maximum dimension of about 1 mm, but typically fiber size is less than about 0.8 mm, typically less than or equal to 0.4 mm. We have found that short fiber used in the composite is preferably a cellulosic fiber such as fiber derived from cotton, wood, or other similar cellulosic fiber sources; inorganic filler materials such as mica or glass-like materials such as glass fiber, borosilicate glass fiber, etc. The preferred wood fiber for use in the invention is a wood fiber typically derived from forest resources as a direct product of wood processing or as a recycled or waste stream from wood manufacture.

PATENT-FAMILY:

PUB-NO	PUB-DATE	LANGUAGE	PAGES	MAIN-IPC
JP 50101698 A	August 12, 1975		000	
JP 83028389 B	June 15, 1983		000	

INT-CL (IPC): D06M 13/32; D06M 15/52

Full	Title	Citation	Front	Review	Classification	Date	Reference	Sequences	Attachments
Draw Desc	Image								

KIMC

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Term	Documents
SULFONATE	74684
SULFONATES	34888
SULPHONATE	35768
SULPHONATES	10998
SULFATE	278517
SULPHATES	19247
SULPHATE	125172
SULFATES	51087
PHOSPHATE	339220
PHOSPHATES	72977
((SULFONATE OR SULFATE OR PHOSPHATE) SAME (POLYTETRAMETHYLENE GLYCOL OR POLYESTERDIOL) SAME (FIBER OR FIBRE)). USPT,PGPB,JPAB,EPAB,DWPI,TDBD.	12

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Experimental Procedure:

PVC compound was blended in a Littleford laboratory blender using the following procedure: Resin (Geon 427, IV=0.92) and Morton TM 181 (tin mercaptide heat stabilizer) were added to the blender and allowed to mix until the temperature reached 130 degrees F. The blender was stopped and the remaining ingredients found in Table 1 were added and blended until the temperature reached 195 degrees F. The powdered PVC compound was mixed with 40 mesh sawdust and either cotton linter fiber or fiber glass. The formulations of the PVC compound and the ratios of the fibers are shown on the top of Table 1. As a control, samples were run with the base resin and fiber glass only.

centigrade for zones 1-5 respectively. The 100 percent sawdust filled and fiber glass filled samples were directly extruded without being compounded in the mixer.

Samples were retained from both extrusion passes for Instron physical testing using standard test method #2 (0.0500 inches/minute crosshead speed, 2 inch gauge length extensometer, and 1124 pound load cell). Samples were allowed to equilibrate at ambient conditions for 24 hours before Instron testing. Results of the testing are found in Table 1. Gardner impact testing (ASTM Method D3029) was done on one inch wide strips at room temperature using an 0.87 pound weight and a 0.5 inch diameter impactor.

TABLE

FIBER SIZES USED IN THE EXPERIMENTAL WORK							
COTTON Long		FIBERGLASS Long		WOOD Short (35 Mesh)		WOOD Short (18 Mesh)	
Length	Diameter	Length	Diameter	Length	Diameter	Length	Diameter
0.3-0.5	0.000592	0.11189	0.000608 × 5				
	0.000605	0.1217	0.000532 × 2				
	0.000608	0.1185					
	0.000410	0.1169					
	0.000942	0.1232					
	0.000653	0.1220					
	0.001171	0.1220					
	0.000516	0.1232					
	0.000302	0.1256					
	0.000329						
Average	0.4			1.45	0.57	3.84	0.73
Aspect Ratio*	653	207		2.81	9.00		

Cotton linter fiber was obtained from Buckeye Cellulose Corporation of Memphis, Tenn. The fiber was used as obtained and had a moisture content of 4 percent. The 40 mesh sawdust was obtained from American Wood Fibers of Schofield, Wis. The sawdust had a moisture content of 6 percent. Fiber ratios reported are on a dry fiber basis. Fiber glass used in this experiment is Owens Corning 497 DB obtained from the manufacture. Cotton linter fibers and fiber glass used in this experiment have an aspect ratio (length/width) of greater than 100, the sawdust has a ratio of less than 3.

Cotton linter samples were compounded on the Brabender Prep Mixer, equipped with roller blades, for 12 minutes at 30 rpm and 185 degrees centigrade. Fluxed material from the Prep Mixer was ground in a Cumberland rotary grinder and extruded on the Brabender laboratory (35 mm parallel twin screw) extruder. Cotton linter samples were reground and run a second pass. Extrusion conditions were as follows: 15 rpm, temperatures of 195, 185, 180, 175, 180 degrees

Results:

Results of the Instron physical property testing is found in Table 1. FIG. 1, which illustrates tensile modulus versus percent cotton linter fiber, depicts the break point in physical properties at the 20 percent long fiber concentration. FIG. 2, tensile modulus versus glass fiber concentration, shows a similar trend with an improvement in the graph containing 40% wood fiber. FIG. 3, impact energy versus percent fiber glass, portrays the same trends of a threshold level of addition. The increased impact energy at (e.g.) 15%-30% glass and 40% wood fiber is surprising. There is a corresponding threshold value for both high aspect ratio fibers. Composites samples with long fiber concentration of greater than 20 percent exhibit a high percentage the enhanced properties of the composites containing a greater fraction of long fiber. Composites with less than 20 percent of the long fiber are closer to the physical property characteristics of the pure sawdust composites.

TABLE 1

STABILIZER	TM 181	TM 181	TM 181	TM 181	TM 181
MANUFACTURE	Morton	Morton	Morton	Morton	Morton
FORM	Liquid	Liquid	Liquid	Liquid	Liquid
PHR	1.50	1.50	1.50	1.50	1.50
Witco CA STEARATE	1.50	1.50	1.50	1.50	1.50
Allied Signal AC	0.20	0.20	0.20	0.20	0.20
629	2.50	2.50	2.50	2.50	2.50
Rohm & Haas K 120N	1.00	1.00	1.00	1.00	1.00
Henkle HOB 7162	4.00	4.00	4.00	4.00	4.00
Henkle VGE 1884					
Wood Fiber	0%	10%	20%	30%	40%
(40 Mesh- 0.4 mm)	40%	30%	20%	10%	0%
% Long Fiber	COTTON	COTTON	COTTON	COTTON	COTTON

<u>Set Name</u>	<u>Query</u>	<u>Hit Count</u>	<u>Set Name</u>
side by side			result set
<i>DB=USPT,PGPB,JPAB,EPAB,DWPI,TDBD; PLUR=YES; OP=ADJ</i>			
<u>L6</u>	(sulfonate or sulfate or phosphate) near2 (polytetramethylene glycol or polyesterdiol)	6	<u>L6</u>
<u>L5</u>	(sulfonate or sulfate or phosphate) near1 (polytetramethylene glycol or polyesterdiol)	3	<u>L5</u>
<u>L4</u>	(sulfonate or sulfate or phosphate) near3 (polytetramethylene glycol or polyesterdiol)	9	<u>L4</u>
<u>L3</u>	(sulfonate or sulfate or phosphate) near11 (polytetramethylene glycol or polyesterdiol)	24	<u>L3</u>
<u>L2</u>	(sulfonate or sulfate or phosphate) near (polytetramethylene glycol or polyesterdiol)	3	<u>L2</u>
<u>L1</u>	(sulfonate or sulfate or phosphate) same (polytetramethylene glycol or polyesterdiol)	152	<u>L1</u>

END OF SEARCH HISTORY

